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Beam Injection Dump

Fermilab

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Model

- The system is azimuthally symmetric for simplicity.
- 1 m or 0.3 m in the transverse direction provide an order of magnitude dose reduction. Beam dumps for 20 kW and 40 kW are almost same.
- Beam intensity:
  1 GeV = 1.6×10^{-10} J; 8 GeV = 12.8×10^{-10} J
  N_p=40,000 W / (12.8×10^{-10}) = 3.125×10^{13} proton/sec
- Fermilab soil is wet dirt with $\rho = 2.24$ g/cm^3
- Central part is a block of steel, some part can be replaced with concrete.
- 1 m pass around the dump (for firemen)
- 1'-thick concrete wall

Design Criteria

- Promt Dose on surface (occupied areas)
  $\leq$ 0.05 mrem/hr for normal operation
  $\leq$ 1.00 mrem/hr for accident
  Design driven by normal operation, not accident.
- Hands-on maintenance dose $\leq$ 100 mrem/hr=1 mSv/hr
- Sump water activation $\leq$ 2000 star/cm^3/sec.
  Water activation limit for MIPP (E907) is 5.96 $\times 10^{10}$ star/year/cm^3.
  That corresponds to 0.9536 $\times 10^{-10}$ star/cm^3/1proton for the
  'standard Fermilab year' (2 $\times 10^7$ sec). Star density for hadrons with
  E $\geq$ 50 MeV.

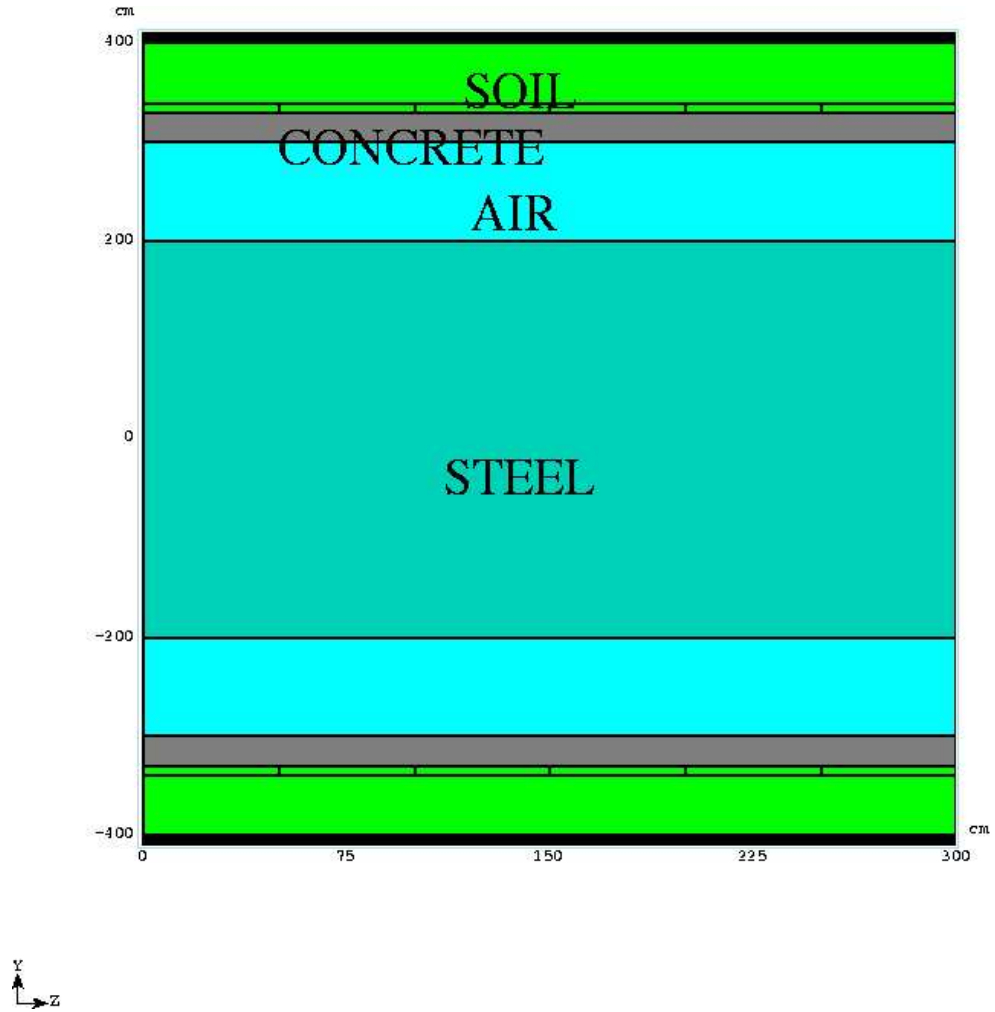

Figure 1: Model.

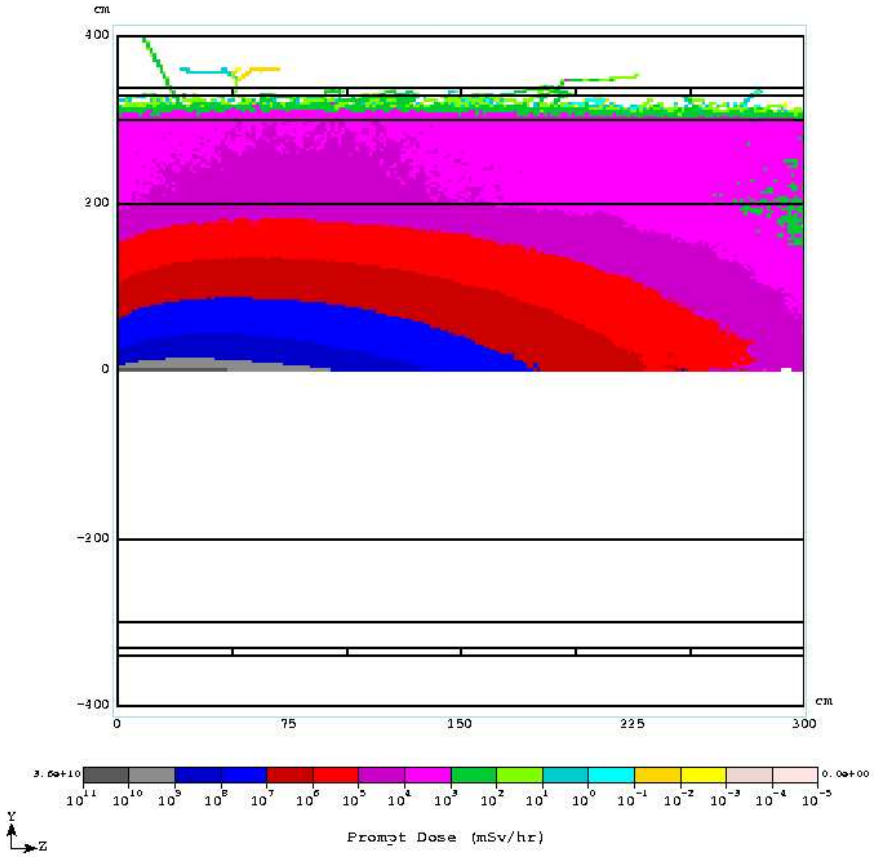

Figure 2: Prompt Dose.

One can not simulate fast many meters of soil (too long). Need an estimate. For 5 m of soil and concrete one expects 10^5 prompt dose rate reduction.

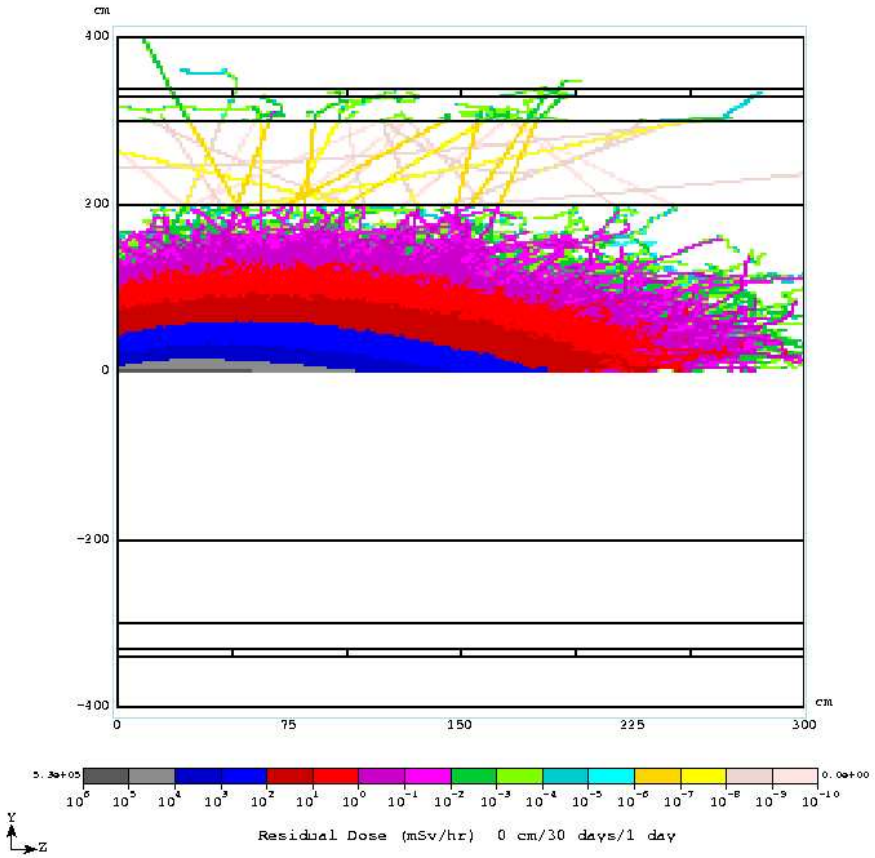

Figure 3: Residual Dose.

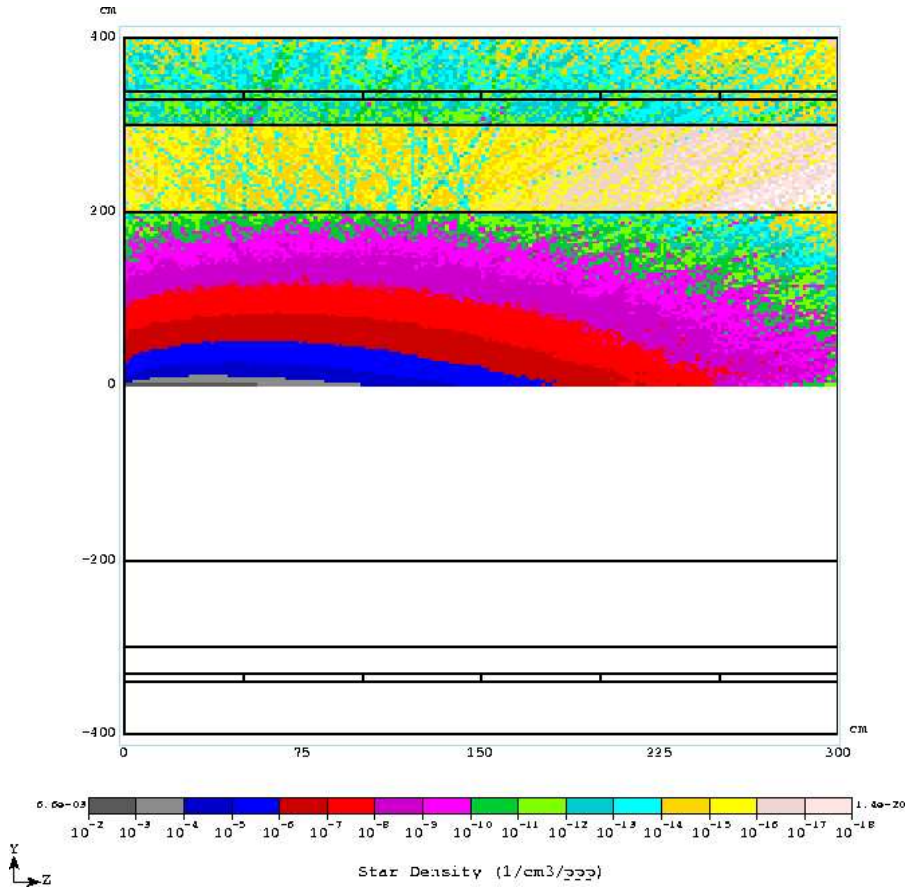

Figure 4: Star density.

$$\text{Star Density}_{max} = (8.114 \pm 3.734) \times 10^{-12}$$

Estimate for Dump Transverse Size

'Minimal Dump':

- steel 3.5 m $\times$ 3.5 m – driven by star density, not by residual dose
- 8 m of soil, less if the area fenced as "Radiation Area".